



ON Semiconductor®

User Guide for
FEBFL77904_L82H08A
FEBFL77904_L82L08A

Evaluation Board
8 W AC LED Driver

Featured Fairchild Product:
FL77904

*Direct questions or comments
about this evaluation board to:
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This user guide supports the evaluation kit for the FL77904. It should be used in conjunction with the FL77904 datasheet as well as Fairchild's application notes and technical support team. Please visit Fairchild's website at www.fairchildsemi.com.

1. Introduction

This document describes a direct AC line LED driver with a minimal number of external components. The input voltage ranges of the LED driver board are classed as low-line application for $98 V_{AC} \sim 142 V_{AC}$, and high line application for $198 V_{AC} \sim 242 V_{AC}$. With a single DC output, constant current depends on the Rcs value. This document contains a general description of the FL77904, the normal configuration specification, schematic, bill of materials, and typical operating characteristics.

1.1. General Description of FL77904MX

The FL77904 is a direct AC line LED driver with a minimal number of external RC passive components. In normal configuration, one resistor is to adjust LED power, and one capacitor is to provide a stable voltage to an internal biasing shunt regulator.

The FL77904 provides phase-cut dimming with wide dimming range, smooth dimming control and good dimmer compatibility. It achieves the high efficiency with high PF and low THD which makes the FL77904 suitable for high-efficiency LED lighting systems.

High wattage design of the FL77904 can be implemented with multiple IC embedded in parallel for street lighting and down lighting applications.

1.2. Controller Features

- The simplest Direct AC LED Driver with Only Two External RC Passive Component
- Wide AC Input Range: $90 \sim 305 V_{AC}$
- Four Integrated High-Voltage LED Constant Current Sinks of up to 75 mA (RMS) Capability
- TRIAC Dimmable (Leading/Trailing Edge)
- Rheostat Dimmable
- High Power Factor (above 0.98 in normal configuration)
- Adjustable LED Power with an External Current Sense Resistor
- Low Harmonic Content (THD under 20% in normal configuration)
- SOP 8LD Package
- Flexible LED Forward Voltage Configuration
- Power Scalability with Multiple Driver ICs
- Over-Temperature Protection (OTP)



1.3. Controller Internal Block Diagram

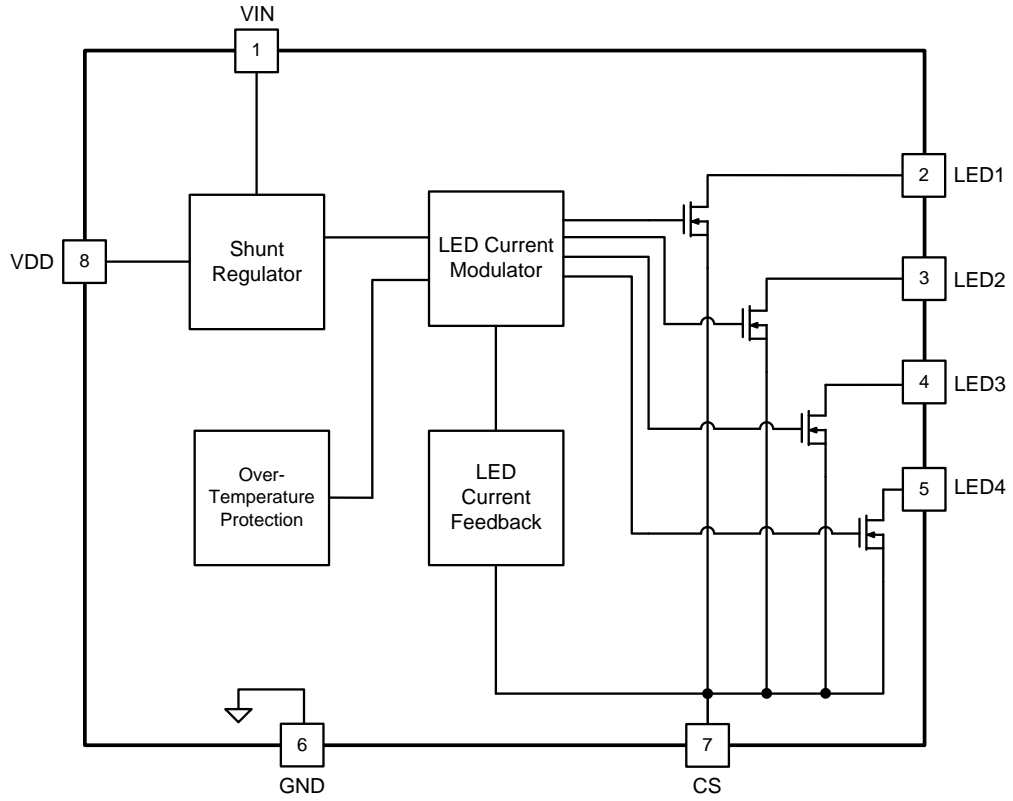


Figure 1. Simplified FL77904 Block Diagram



2. Evaluation Board Test Outline

Table 1. Evaluation Board Test Condition & Equipment List

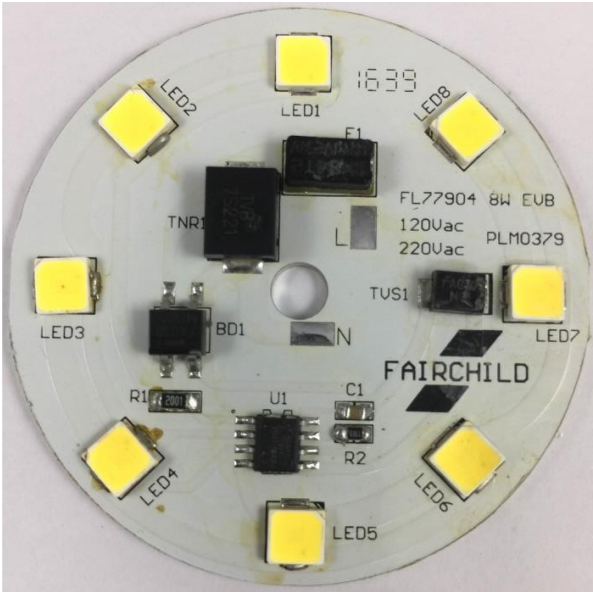
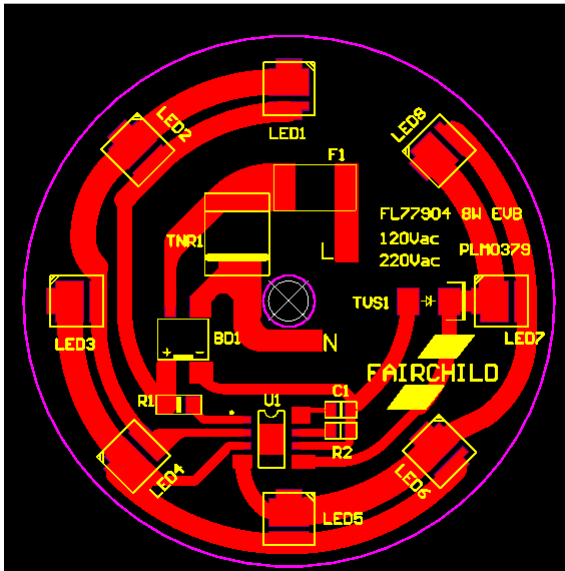
Evaluation Board #	FEBFL77904_L82L08A	Low-Line, 8 W
	FEBFL77904_L82H08A	High-Line, 8 W
Test Date	October- 2016	
Test Equipment	AC Source: 6800 Series Oscilloscope: LeCroy 24MXs-B Power Analyzer: Chroma 6630 Thermal imager: Fluke Ti110 Light measurement: INVENTFINE CMS-8000 Photo Sensor for Flicker Index: ADMESY LM-AST-CC	
Test Items	<ol style="list-style-type: none">1. Startup Performance2. Normal Operation3. Efficacy4. Flicker Index5. Power Factor6. Total Harmonic Distortion(THD)7. Conduction EMI	



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3. Evaluation Board Specifications

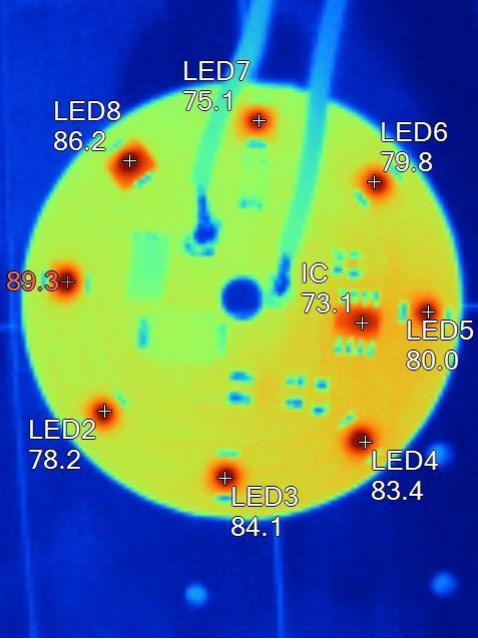
Table 2. Evaluation Board Specifications

<p>EVB PHOTO</p>	
<p>PCB</p>	
<p>Diameter</p>	<p>52 mm</p>
<p>Material</p>	<p>Metal</p>
<p>Thickness</p>	<p>1.6 t</p>
<p>Input</p>	<p>Low-Line: 108 ~ 132 V_{AC}, High-Line: 198 ~ 242 V_{AC}</p>



4. Evaluation Board Operating Temperature

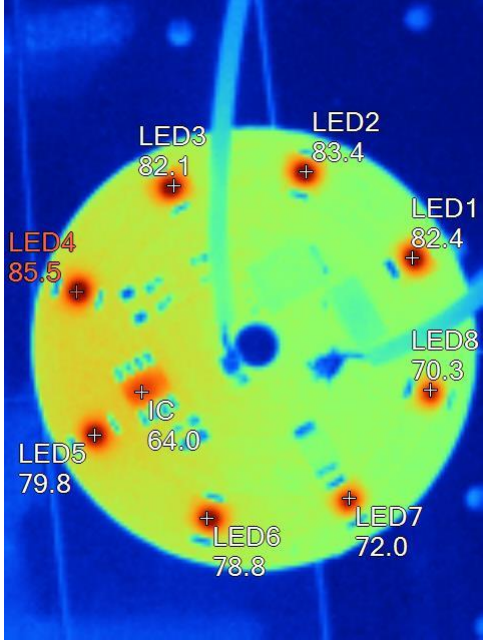
Table 3. Evaluation Board Operating Temperature

	
Test Condition	120 V _{AC} , 30min, Room temperature. With Heat sink: 120 mm * 152 mm * 11 mm
Spot	LED1: 89.3°C LED2: 78.2°C LED3: 84.1°C LED4: 83.4°C LED5: 80.0°C LED6: 79.8°C LED7: 75.1°C LED8: 86.2°C IC: 73.1°C

Temperatures on all components at low line evaluation board are less than 90°C. The IC's temperature is lower than 75°C. Measured temperature can be changed by dimension of heat sink.



Table 4. Evaluation Board Operating Temperature

	
Test Condition	220 V _{AC} , 30min, Room temperature. With Heat sink: 120 mm * 152 mm * 11 mm
Spot	LED1: 82.4°C LED2: 83.4°C LED3: 82.1°C LED4: 85.5°C LED5: 79.8°C LED6: 78.8°C LED7: 72.0°C LED8: 70.3°C IC: 64°C

Temperatures on all components at high line evaluation board are less than 85°C. The IC's temperature is lower than 75°C. Measured temperature can be changed with dimension of heat sink.



5. Evaluation Board Bill of Materials (BOM)

No.	Description	Specification	Type	Location No.	Qty.	Vender	Remark
Common Parts							
1	CHIP-RES	11 Ω	0805	R2	1		Low Line
	CHIP-RES	20 Ω	0805	R2	1		High Line
2	CHIP-RES	2 K Ω	1206	R1	1		
3	CHIP- CAP	0.1 μ F / 25 V	0805	C1	1		
4	Bridge Diode	MB6S (0.5 A 600 V)		BD1	1	Fairchild	
5	Varistor	TVB7S221KR	Size3225	TNR1	1		Low Line
	Varistor	TVB7S391KR	Size3225	TNR1	1		High Line
6	FUSE	2 A 250 V _{AC} MF2410F1.000TM	SMD	F1	1		
7	IC	FL77904	SOIC 8L	U1	1	Fairchild	
8	SMD LED	32VF 42 mA	5250	LED 1~8	8	LGIT	Low Line
	SMD LED	65.4VF 20 mA	5250	LED 1~8	8	LGIT	High Line
9	TVS DIODE	SMBJ100CA	DO214AA(SMB)	TVS1	1	Fairchild	
10	PCB0379 V2	52 Φ	Metal	PCB	1		



6. Evaluation Board

6.1. Evaluation Board Schematic

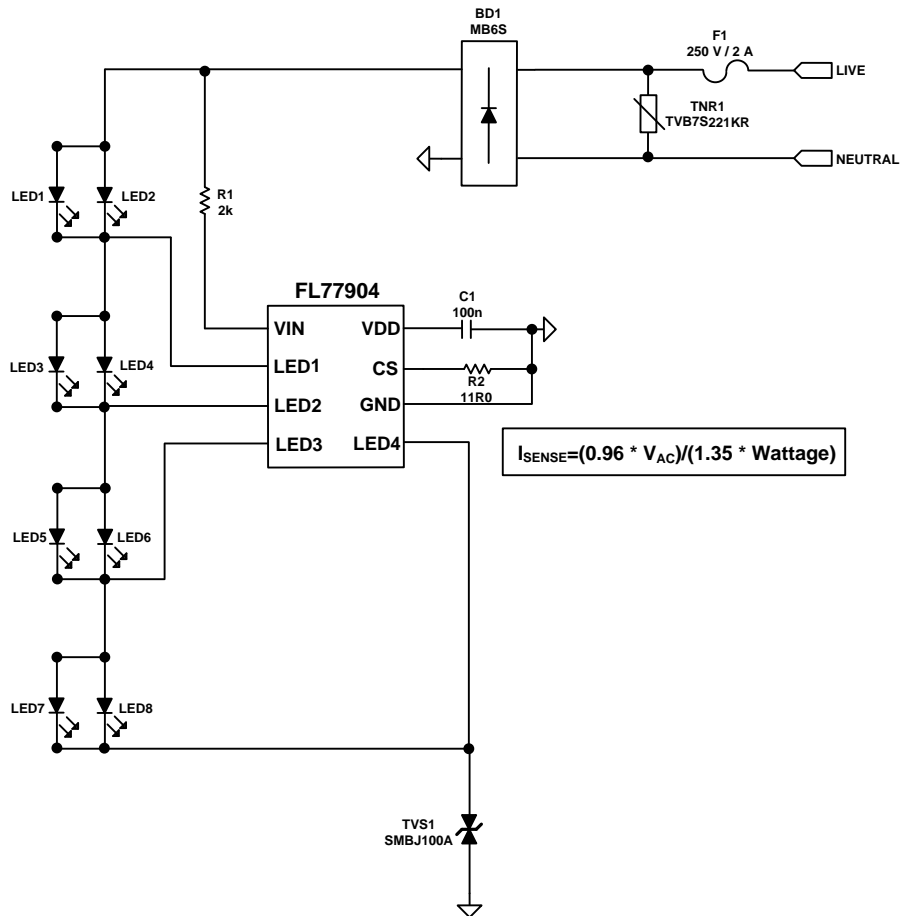


Figure 2. Typical Application Circuit of the 8 W Evaluation Board

Table 5. Evaluation Board Circuit Parameters for High-Line without SVF

Parameter	Value	Unit
Evaluation Board #	FEBFL77904_L82L08A (Low Line)	
	FEBFL77904_L82H08A (High Line)	
Input Voltage	108 ~ 132 (Low Line)	V _{AC}
	198 ~ 242 (High Line)	V _{AC}
Output Power	8	W
LED		
CCT	I _f (mA)	V _f (V)
		Power(W)
		Φ _v (lm)
		Lm/W



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5700K(G)	42 (Typ.)	32	1.34	177	132
5700K(G)	20 (Typ.)	65.4	1.31	167	127

7. Key Performance Measurements

Table 6. Key Performance Measurements for Low-Line EVB

Input Condition	50 Hz			60 Hz		
	108 V _{AC}	120 V _{AC}	132 V _{AC}	108 V _{AC}	120 V _{AC}	132 V _{AC}
Power Factor	0.987	0.991	0.992	0.987	0.991	0.992
THD (%)	15.87	13.21	12.42	16.04	14.21	12.42
Pin (W)	6.71	7.97	9.17	6.70	7.89	9.18
IIN.RMS (A)	0.062	0.066	0.069	0.062	0.066	0.070
Lumen (lm)	599.7	677.5	736.8	599.5	676.5	735.7
Efficacy(lm/W)	89.4	85.0	80.3	89.5	85.7	80.1
Flicker Index	0.38	0.36	0.33	0.38	0.36	0.33

Table 6 shows the key performance measurements result for low line evaluation board from 108 ~ 132 V_{AC} at 50 Hz / 60 Hz. Power factor has enough margin from 0.9 and THD is less than 16% at the input voltage range from 108 to 132 V_{AC}. Measured Lumen can be changed by test environment such as measurement equipment type, standard sample for equipment calibration and integrating sphere type.



Table 7. Key Performance Measurements for High-line EVB

Input Condition	50 Hz			60 Hz		
	198 V _{AC}	220 V _{AC}	242 V _{AC}	198 V _{AC}	220 V _{AC}	242 V _{AC}
Power Factor	0.993	0.995	0.994	0.993	0.995	0.994
THD (%)	11.55	10.06	10.77	11.55	10.08	10.67
Pin (W)	6.79	8.11	9.32	6.78	8.10	9.29
IIN.RMS (A)	0.034	0.036	0.039	0.034	0.037	0.038
Lumen (lm)	617.0	715.2	785.1	617.0	714.5	783.1
Efficacy(lm/W)	90.9	88.2	84.2	91.0	88.2	84.3
Flicker Index	0.35	0.33	0.31	0.35	0.34	0.31

Table 7 shows the key performance measurements result for high line evaluation board from 198 ~ 242 V_{AC} at 50 Hz / 60 Hz. Power factor has enough margin from 0.9 and THD is less than 12% at the input voltage range from 108 to 132 V_{AC}. Measured Lumen can be changed by test environment such as measurement equipment type, standard sample for equipment calibration and integrating sphere type.



7.1. Startup

Table 8. Startup Waveform according to Variable Input Voltage and Frequency

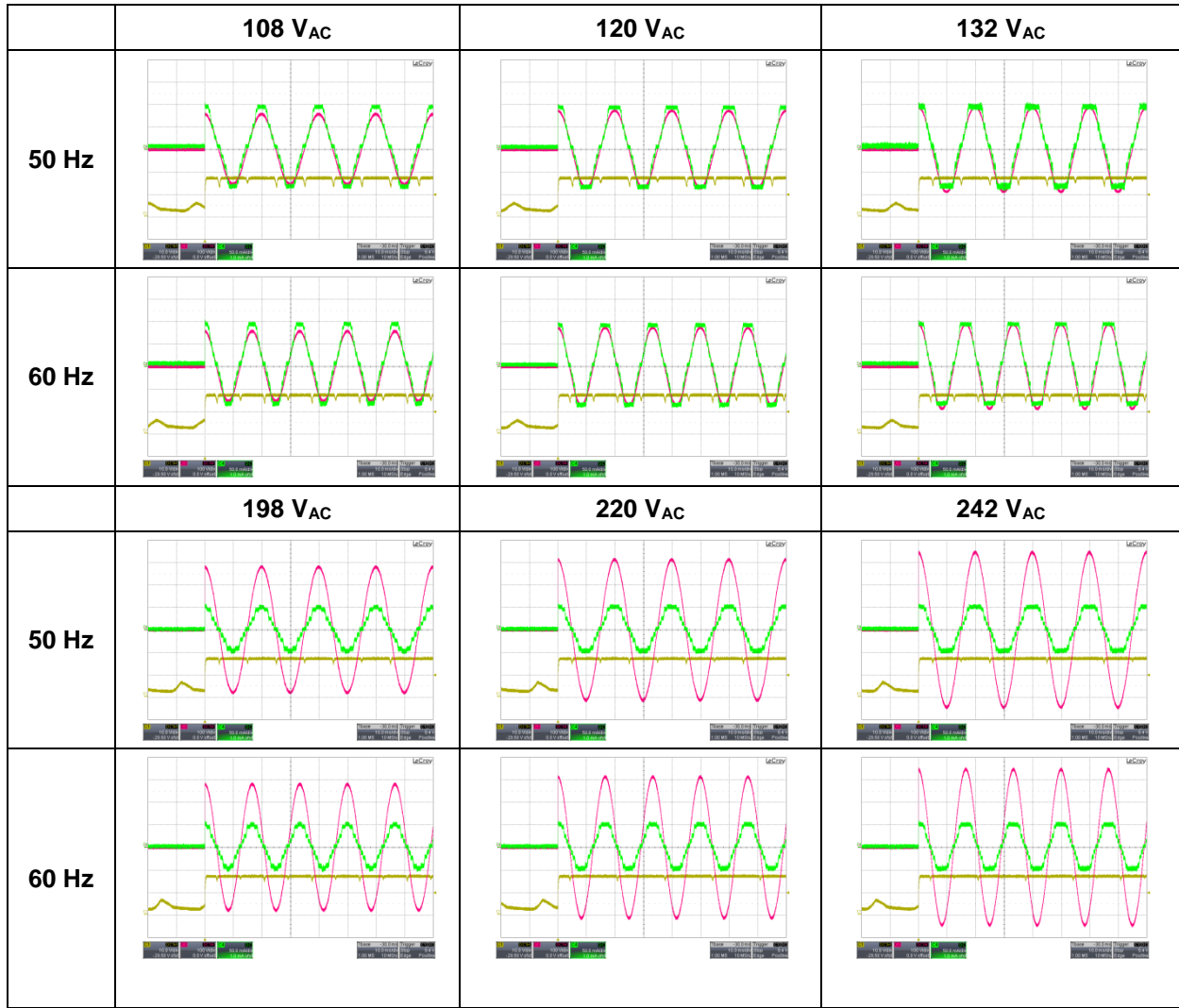


Figure 3. Ch1: VDD 10.0 V/div, Ch2: V_{IN.ac} 100 V/div, Ch3: I_{IN.ac} 50.0 mA/div

Table 8 shows overall startup performance at each line input voltage with 50 / 60 Hz. Input current flows immediately when input voltage is applied.



7.2. Normal Operation

Table 9. Normal Operation Waveform according to Variable Input Voltage and Frequency

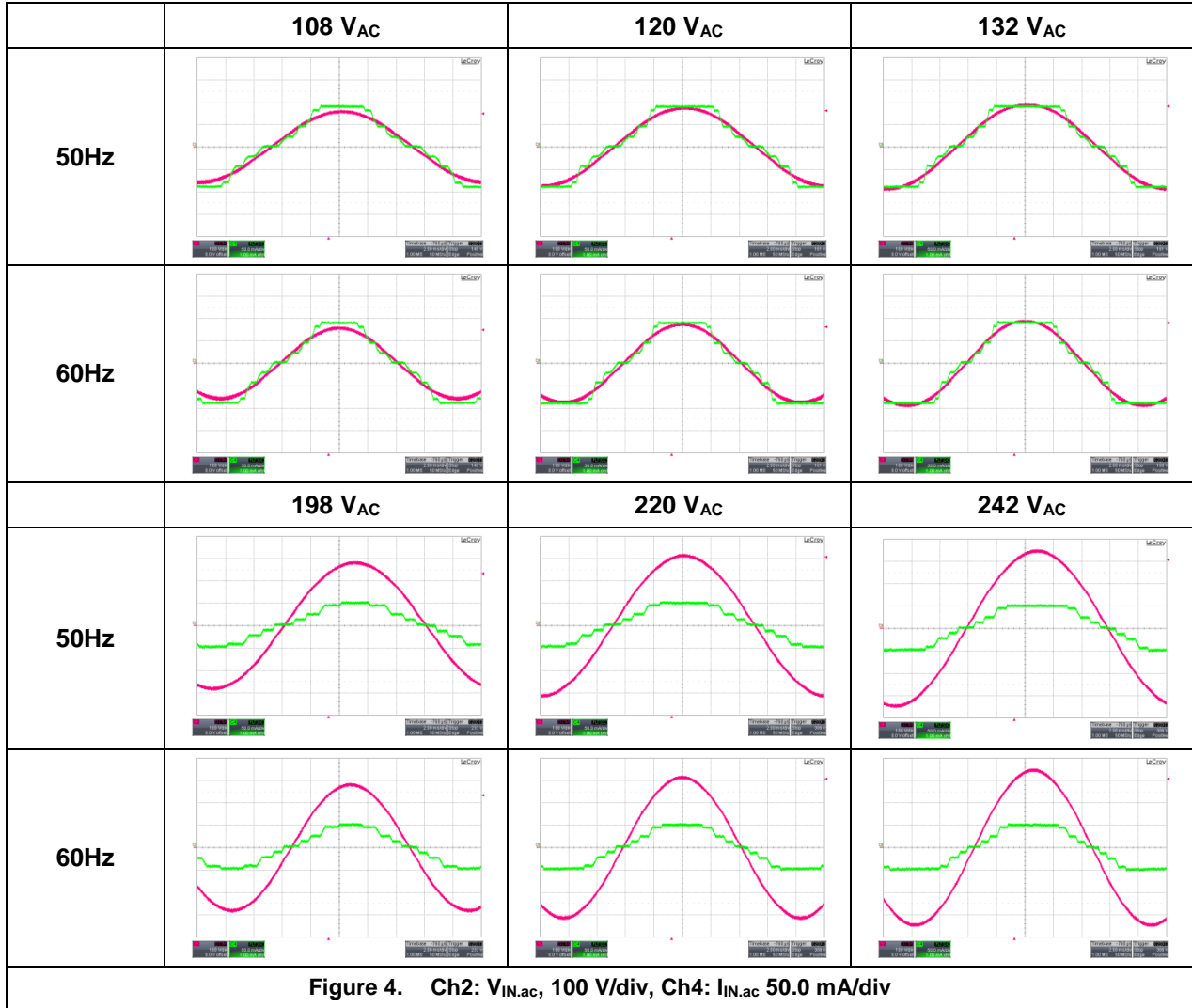


Table 9 shows overall normal operation performance at each line input voltage with 50 / 60 Hz. When input voltage is higher than all string LED forward voltage, LED 4 pin can be conducted and its time depends on input voltage and line frequency.



7.3. Electromagnetic Interference

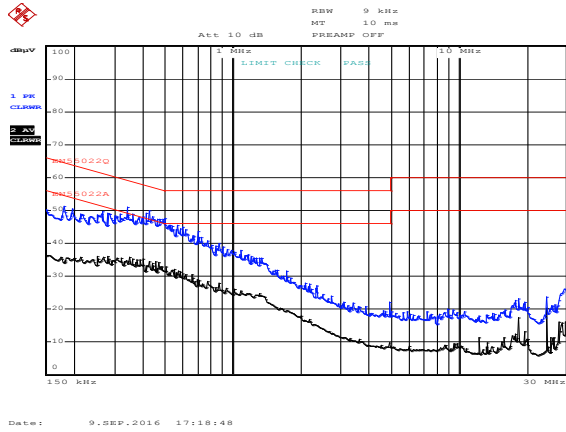


Figure 5. 120 V_{AC}, 60 Hz, <L>.

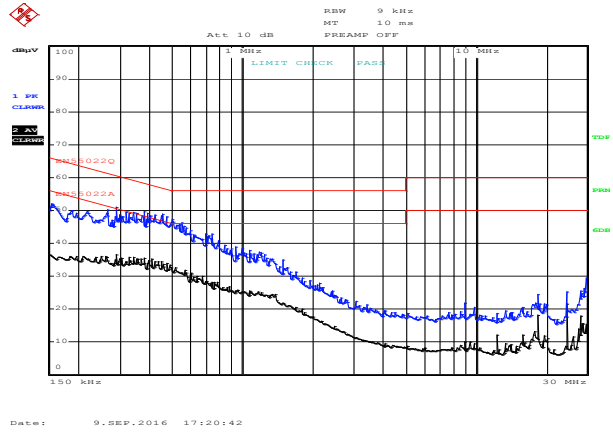


Figure 6. 120 V_{AC}, 60 Hz, <N>.

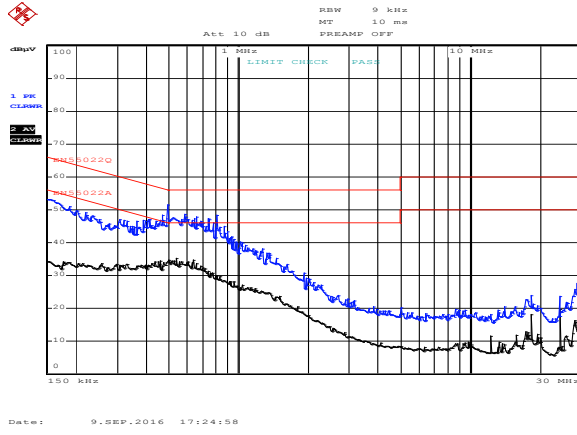


Figure 7. 220 V_{AC}, 60 Hz, <L>.

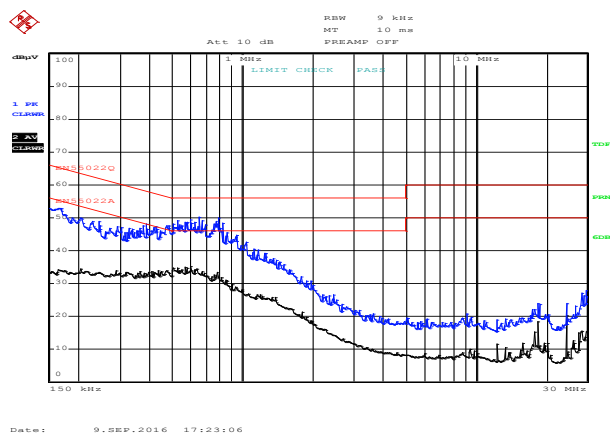


Figure 8. 220 V_{AC}, 60 Hz, <N>.

All measurements were conducted in observance of EN55022 criteria.

7.4. Surge Test

Input Voltage [V _{AC}]	Surge Type	Injection Location	Surge Level [kV]	Result
120	Line	L1 and L2	1.5	Pass
220	Line	L1 and L2	1.0	Pass



8. Revision History

Rev.	Date	Description
1.0	Nov. 2016	Initial Release

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